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An Inaugural Dissertation on the Physiology of the Brain and Nerves

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of
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"Spiritus intus alit, totam que infusa per artus
Mens agitat molem, et magno se corpore miscet."

September

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That the true Philosophy of life is only to be found in a knowledge of the Nervous Functions, is an opinion which intelligent research and ingenious experiment is rapidly advancing to the certainty of truth.

Admitting, as we must do, that in the Brain and Nerves reside the first motive and percipient principles of our system; Medicine must ever remain an empiric art until a knowledge of these organs fills the volumes of its system, and becomes the data of its practice, and science will in vain extend to nature's verge, while it confesses the humiliating truth, that on of all subjects she, are to ourselves the most unknown — It would be interesting to inquire why this sublest effort of creation skill, has so

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The discussion of the Question: What is Life? has startled from their lethean rest, the gloomy ignorance and bigotry, or has kindled the most brilliant meteors of false but ingenious science. By the former the pursuit has been charged with daring impiety and presumption, as if our corporeal structure and functions had alone violated the system of nature, or that in us alone the Creator had dispensed with the relations of cause & effect as subservient to his designs. — But so far as nature unfolds her plans, is this presumption true — In the eye we see changes can occur to suit the variations of a physical ~~cause~~ agent — in our muscles the most perfect adaptation to mechanical laws, both in structure and operation; and why may we not suppose that the less obvious processes of our organs may also be the

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result of the relative but modified properties of matter — There is no element to be found in our structure that is not furnished from the common laboratory of nature, but imbued with the new property of life, we do not expect to see it exhibit ordinary affinities. — Hence we hear it boastfully alleged by the advocates of the "vitality of Life" that chemical laws are suspended by its influence. Be it so: but have not the relative and ordinary affinities of a salt been changed by the mystic and invisible influence of galvanism & been made to pass the test of an acid unchanged? And ~~as~~ until our acquaintance with the elementary laws of matter is more accurate, let it not be said that it is not by some modified agency of the same forces, that we have our Conservative, Assimilative & Temperative functions. Dr Godman has said that — "the laws of life place the materials in a proper relation, and

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2 Article 3d Vol 5d

the laws of affinity combine them together."‡

But if ignorance and contracted views have retarded investigation into the nature and laws of the vital principle, by at once referring all its operations to some preternatural and inscrutable cause, why have the efforts of men of science been equally unavailing? — It is because the observation of facts, and the scrutiny of experiment have been neglected. — Not contented with laboriously ascending link by link in the lengthened chain of causation, they have exhausted their intellects in aspiring to comprehend the ultimate nature of mind and matter — They have overlooked the "matter of fact, by attending solely to the manner of the fact — Hence have originated the ideas of Ethereal Essences, Vital Spirits &c. — And we see them

‡ Article 3d Vol 5 Phil. Med. Journal

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trace sensation along a nerve, and formally describe its introduction to the sentient mind with all the solemnity of an actual observer.

Happily for Physiology it now obeys the precepts of Bacon, of which it, alone, of the Sciences had been disinherited, and as much has been, much more will be effected by the labours of such men as Le Gallois, Magendie, Phelips & Bell.

The Brain and its appendages are indicated to be the most essential organs in our system by the extreme care with which they are ~~protected~~ guarded from external injury, or internal derangement - the admirable architecture of the cranial and facial bones unites strength with the requisite lightness; while the elastic membranes afford to the exquisite texture of the cerebral mass an equable support. Cuvier says that in some animals that run fast, the tentorium is osseous,

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as in the cat, proverbial for its daring agility.— The Brain in its extent is always proportionate to the rank which the animal occupies in the grade of being; hence in man the ratio of its volume is greater than in any other animal — This implies his vast intellectual superiority; while to many other animals must be granted a greater perfection of motion and sense, except, as Bichat says that of touch, which is dependant more upon the judgement, than any organic structure. — Cuvier represents the weight of the brain in man to the weight of his body as 1: 30, but in the majority of animals this proportion decreases — To this there are some few exceptions, of which Professor Warren has availed himself to disprove the general conclusion — To this it may be replied that the violent propensities of these animals, and the acuteness of their senses may require of the parts of the brain connected with

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their functions, a development that will give to the aggregate, a much greater proportionate weight. Lamarck informs us that "in the animal had he even found an encephalon, whose proportion to the nerves connected with it made any approach to that of the human subject". As we descend to the lower grades of existence, we find the nerves more voluminous, and the powers of life less accumulated in any particular part, and this gives to them their superior tenacity of life+ - This is remarkable in the Mollusca, Crustacea & polypi. - The Brain also bears a greater proportion in man to the spinal marrow, than in any other animal. - These facts will hereafter afford presumptive proof, that the nerves & spinal marrow are but prolongations of the brain, and that they are not merely intermediary chords, but that they have powers coordinate with, or independent of the Brain. The Brain bears a greater proportion to the cerebe-

+ Cuvier's Comparative Anatomy P. 103. Vol. 2.

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cum, and also to the medulla oblongata, in man than in other animals, and "this", remark M. Bommering and Ebel "is an excellent criterion of the degree of intelligence an animal enjoys, because it is the best index of the pre-eminence, which the organ of reflexion possesses over those of the external senses"+ —— Chemical analysis has given no addition to our knowledge of the functions of this organ — M. Vauquelin declares that all parts of the nervous system present the same composition — The microscope has been equally unsatisfactory — Malpighi thought that the cortical substance consisted of glandular follicles, and that the medullary was composed of the excretory ducts.

Ruysch & Leeuwenhoeck opposed this idea & declared it to be entirely vascular — Fontana & Ried thought that they saw minute globules, contained in cylinders, that are convoluted like the intestines — Sir E. Home denies the tubular structure

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ture of the nerves, and says that they are fasciculi of fibres different from any thing else in the body, with their interstices filled with a transparent Jelly. Gall, Spurzheim and Serres are convinced of the fibrous structure of the brain. All agree that its minute structure is singularly curious, and most probably essentially connected with the function of the organ.

Development. — That there exists in the embryo, a perfect representation of the future animal, is an opinion that modern physiology has abandoned, & in its place advanced the idea that all the parts are successively formed, and increase in complication & approach to perfection, as they remove from their most simple element, and assume a higher grade of organization — Thus in ~~man~~ the first rudiments of man we will discover the germs of its nervous system, but at this time corresponding to the perfect development of some inferior order.

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"Let us" says M. Serres, "go far back in the uterine life of the mammiferæ: you will perceive at first the cerebral hemispheres rolled as in fishes, into two vesicles separated from each other. After a time, you will see them affect the configuration of the cerebral hemispheres of reptiles; at a later period again, they will exhibit to you the appearance of those of birds: and finally, it is only at the epoch of their birth, and sometimes later, that they acquire the permanent forms which the adult presents in the mammiferæ."

To the same ingenious and philosophic writer we must be indebted for what we shall say on this part of the subject — An "Excentric Development" is observed in the formation of all the parts of an animal body — Every part will be primitively double & isolated in its situation — Each part will correspond from the "law of symmetry," and as their growth progresses, will approach, and unite at the median line, by the "law of conjunction" — Thus

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in the osseous system the ribs are first formed, & approach to the less perfect vertebra, when processes are and seem to arise, and then two half canals, where ~~fused~~ final union forms the perfect column — And so with the pelvis, heart, intestines, & all other parts.

In the tender embryo the lateral nerves are first formed, and exist independently of the Brain and S. Marrow — They are in fact complete in form & consistence, when the cerebrum and medulla spinalis are liquid — The spinal marrow consists at first of two chords, right & left, which first interlock at their anterior part, and at a subsequent period at their posterior part, leaving a tube in the centre of the axis — Likewise the crura of the cerebrum are primarily double — The cerebellum consists of two lateral plates, and the commissures are also originally distinct — These then are the steps, by which the nervous system ascends thro' the nervous systems of fishes, reptiles and birds to the full display of the brain

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in man, and certainly this formation best adapts itself to our ideas of the homogeneity of the nervous formation, and of the gradation by which one class of animals glides into another and superior one. By this the anomaly of acephalous existences is explained. For it is observed that "the various deformities never pass the limits of their class to assume the forms of a superior one" +

Coincident with many of these observations are those of Gall & Spurzheim — The convolutions a critical matter, they are to be the matrix from which the medulla & the nervous fibrils arise, and in favour of this opinion there is much circumstantial evidence. This substance forms the periphery of the brain, the centre of the spine, and is also collected in small masses in the substance — By Luduig all the parts of this substance were said to communicate — The line of demarkation between it, and the medulla is distinct, and there is some appearance of an inter-

+ North Am. Med. & Sur. Journal p. 120. Vol 1.

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vening substance — They conceive that all the nervous expansions are covered with it, as in the retina mucosum, retina &c — Prof. Horner has ingeniously thought that the fibres of muscles, the surface of the skin, & other sensitive parts may possibly receive something like a coating of nervous matter"[+] — G & S. suppose this cortical matter to be the soil of the nerves, since its quantity is always proportionate to the trunks arising there from, and it is always to be found at the origin of the nerves — It produces as many particular systems as it forms ganglions, and these ganglions not only enforce the nerves, but also modify their functions — The M. Spinalis is distinctly a chain of ganglions in the caterpillar, and the same arrangement gives the undulated appearance ~~of~~ to that of the mammifera — The anterior and posterior fascicules of the vertebral nerves emanate from the ends of the internal arcs of the cortical matter, and are always proportionate to the swelling of the ganglions whence they arise — The medulla

+ Prof. Chapman's Journal p. 288 - Vol 1.

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oblongata joins this last, contains the ganglionic centres of two nervous substances, and gives rise to most of the nerves of the senses — An elementary chord arises from within the M. O., ascends toward the cerebellum, and immerges into a penated body called the Corpus Dentatum; whence a decussated band of medullary fibres are dispersed in about 11 branches to the periphery of the cerebellum, where size is always proportioned to that of this penatick — The cineritious substance is more pronounced in the cerebellum, than in the cerebrum, as a transverse section shows.

After the Corpus Pyramidale has been formed in the medulla oblongata by the decussation of fibres from opposite sides, it contracts its diameter, and enters the pons varolii; whence they receive additions of optical matter, as also from the corpora olivaria posterior part of the M. O. — Thus reinforced the pyramidal and olivary fasciculi ascend to the corpora

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striata, and optic thalami — Enlarged in these bodies they expand their fibres to the whole periphery of the brain — Beyond the lipse in which enters the base of the convolutions there is a peculiar nervous matter — This tho' at first in layers forms more intricately distinct ~~layers~~ fasciculi, which converge untill they meet their fellows of the opposite side, when either by a simple juxta-position, or intralacing of the fibres they form all the commissures — The ventricles of the brain are formed by the opposing layers of the converging and diverging fibres — Each convolution consists of ~~a layer~~ the duplicature of a layer of the medullary matter, whose external surface is clothed with a layer of cortical matter; and this is made evident by the slow action of some distending fluid as in hydrocephalus, or by an artificial unfolding — These anatomical views of G. & S. are highly interesting, as all the parts of the curious structure of the

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brain are shown to concur in a connected and uniform design, and are not the result of a careless or fortuitous arrangement, as many have ~~supposed~~ supposed – Also, the idea is rendered probable of the existence of independent nervous systems or organs, by which alone can all the varied and extended operations of life and intellect be explained. So novel & unexpected are the discoveries of G & S. that it is happy for their reputation that their anatomy meets the concurrence of such men as Tiedemann Sommering & Lizars.

The nerves are divided into those of animal life and those of organic – The first by Bichat are derived solely from the brain & the spinal marrow: the last from the ganglions, but the accuracy of this division is not allowed – The pairs of animal life are generally symmetrical – Their primitive fibrils appearing first the form of filaments, and then of chords, issue from their foramina invested with a sheath of the

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* Morbid Anat. Med.

dura mater, which loses itself in the periosteum & cellular texture — The pia mater takes the form of small canals, in which is contained the nervous medulla — Almost all the nerves anastomose, and form plexuses in which the different nerves are so mingled that the branches cannot be traced to any of the formative chords — The filaments in the interior of the chords also communicate, but simply by contiguity, and this fact corroborates the idea of each filament possessing a distinct endowment — What may be the ultimate structure and disposition of the nerves is still unknown, but it is thought that they ultimately lose their investing membrane, and only allow their medulla to penetrate the various structures. M. Bogros is said not only to have injected the neurilematic tubes, but also to have proved the medulla itself tubular — After having destroyed the neurilema, he was able to pass quicksilver thro' the medullary fibrils.+ The nerves receive blood which seems from the experiments of Reil to act as a stimulant; and there is little doubt but

+ North Am. Med. & Surg. Journal p. 209 Vol 1

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that the medulla is the result of a secretion, and not an emanation from the brain, since in the latter case, the lower portion of a nerve (divided) would rapidly decay which is not the case — A nerve whose function is long disused appears to degenerate into cellular substance, a fact perfectly analogous to other secretory structures. —

How do the Cerebral & Nervous Organs commence their functions? If, as Bichat declares, the action of the lungs, and circulation of the red blood be requisite to the functions of the brain, and the office of the former be dependant upon an influence derived from the latter, we may inquire, whence is this circle of operations to find its first moving power — He alludes to "a sympathetic "excitement that the brain experiences from the skin & "mucous surfaces, which the external agents act upon". That "the lungs and the brain influence each other reciprocally at this period, the first by sending red blood to the second, and this by putting in action the diaphragm and the intercostal muscles, which make the air that

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* Gen. Anat. p 240
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is necessary for the production of this and blood penetrate the lungs"[†] Thus he strangely exhibits the lungs as executing this function before the diaphragm & the intercostals are in action — Dr Hopkinson in his Inaugural Essay on the Nervous Functions observes that the child never attempts to breathe until the face is exposed to the contact of the atmosphere — He asks if this may not be attributed to the action of the cold air upon the respiratory nerve of the face (the portio dura), which transmits this action to the brain, and sets the whole respiratory apparatus in motion[‡] — Here the portio dura is not a nerve of irritability, according to Mr Bell's & Dr H's experiment, and in addition to this, its kindred nerves, as the spinal accessory, & infacial respiratory are distributed to the neck & thorax, and should equally feel the influence of the stimulating atmosphere, with the respiratory nerve of the face — Besides this it is not conceivable, that a nerve at this time could commence an action, when the organ whence

† Gen. Anat. p 240 Vol 1
‡ Prof. Chapman's Journal p. 242. Vol 6.

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it derives its power, is at this time totally inoperative — We should rather suppose that all the muscles of respiration, those of the glottis as well as the thorax receive a direct but temporary excitement from the stimulus of external agents, by which the first motions of respiration are performed — The efficacy of the means resorted to in cases of accidental asphyxia, and of delayed respiration at birth strongly corroborate this explanation. Bichat observes that the nerves in their development in the fœtus are not proportioned to the parts they supply,+ thus proving as he thinks how little effect they exert on nutrition — This may apply to the fœtal state, but not so on entry to the independent existence — May not there be derived from the Mother a principle analogous to the nervous agency, either generally diffused thro the blood, or otherwise bestowed — There must have been a time when the "fœtus vaticus" derived its nervous energy from a foreign source, and why may not the same power be occasionally extended thro'

+ Gen. Anatomy pp 233. 239

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During the fœtal State does the brain receive sensations? Bichat says that the "Brain is then in the expectation of action" but that its activity is not necessarily active. As its organization is not complete until a late period of gestation, and as the impression of red blood is indispensable to its action, we are at liberty to ~~suppose~~ infer that its function at that period is not requisite for the purposes of organic life, and surely it but comports with the benevolence of the Creator to suppose that the sensibilities of animal life are not then existent — With organs adapt to requisite sensation, and limbs capable of expansion, how miserable would be its existence in its dark and narrow abode, and how tortuning would be its pangs in the hour of birth — Rather then let us suppose that the exercise of its functions is kindly deferred until

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† Gen. Ana. p. 24

the proper field for their action is afforded.—
In Infancy the sensations are vivid and commotion bespeaks the vivacity of the sensations — Organic and functional disease of the nervous system predominate at this period† — In adult age the organs of reflexion gain the ascendancy, and the senses are more the means of instruction, than of pleasure, no longer as in infancy experiencing delight from every motion, every sound — Old Age exhibits the senses impaired, the brain and nerves much firmer, darker & less enriched with blood: and we will not think that these appearances are connected with the feebleness of mind, the incapacity of pleasure, and the sensibility to pain, so characteristic of this age.

Nervous Functions —

Having thus given the descriptive anatomy of the brain and nerves, we proceed to describe the offices they perform — The functions of the cerebral system may be divided into Animal & Organic.—

† Gen. Ana. p. 492. Vol 1

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Under the first should be enumerated those having a relation to the Intellect, Propensities, Senses & Locomotion — Under the last all those functions that assist in the grand operations of Nutrition, calorification and vital preservation — Dr. Philip divides the functions into Sensorial, Nervous and Muscular — The first are the result of vital parts affecting each other by their vital properties — The two last the result of inanimate agents acting upon vital parts. —

It is a question of interest and importance, whether particular parts of the brain are appropriated to particular functions, and whether the nerves of the various organs are different in inherent qualities as they are in external form & distribution — The older philosophers amused themselves with assigning to different parts, the distinction of being the honoured residence of the soul — The pineal gland, the corpus callosum, the hallitus of the ventricles have alternately

+ Med. & Chir. Review 604 Vol 3

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honoured with the selection — Haller supposes the soul to reside in all the medulla — Locke and Newton, where the nerves meet; but the attempt is idle. We may find the organs mediating between the mind and its objects, but its own immediate location is an inscrutable mystery. The organs of the intellectual and moral faculties have by G. & S. been supposed to ~~reside~~ have their base in the circumference while their apex terminates at some undiscovered internal point. To this it has been objected that large portions of the brain have been removed, without a corresponding injury to the intellect; but no one can assert that the whole of an organ essential to a faculty has been removed — These organs are also double, and besides, since all the various powers of the mind depend equally upon the integrity of all parts of the brain, it would be easier to discover the failure of all the faculties, rather than the injury of an individual one — Sir E. Home has suggested that we may derive important conclu-

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sions by comparing the results of injuries to this organ variously inflicted and treated. — He gives a number of instances. The military histories of Larrey, Hennen & Hughes are curious in this point & would have been much more so, had their attention been directed to its physiological bearing. Loss of the generative faculty and atrophy of the membrum virile followed a sabre wound, which cut off the external protuberances of the occipital bone. — A Portuguese soldier, complained to Staff-Surgeon Hughes that a shell which had taken off a large part of the occipital bone had completely carried his virility away with it — Violent priapism was traced to the effusion of four drachms of coagulable blood beneath the edge of the tentorium. Loss of memory followed an injury of the frontal and parietal bones. In another case the power of distinguishing objects was lost while memory remained. An injury of the parietal bone near the frontal

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occasioned the entire loss of speech. A soldier wounded in the head forgot his own language and formed another; and a case is familiar to all, where a woman from a wound of the head, was made to speak Welsh tho' she had not done this for 20 years.

From all these cases we are taught that individual faculties may be totally lost by partial injuries, while the other faculties may retain their full power. What other inference can be drawn but that the mind manifests itself thro' individual organs, and is itself composed of various, and in a measure, distinct organs — The parts of the brain to which the nerves ~~arise~~ of sense are traced are indispensable to the performance of their functions — The tubercula quadrigemina whence the ~~parts~~ optic nerves arise have been found atrophied when the sight was lost — A tumour in the tuberculum annulare & water in the ventricles caused the loss of sight in one eye; dullness of hearing & difficulty of swallowing, so as to cause starvation with

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all the mental faculties entire — In a case where the tub.ae annulare had become extremely hardened, and the cerebellum & cerebrum much softened, the effects were that the boy was always an idiot, never walked, spoke or understood what was said — Here evidently the effects might be traced to the injury of the reflective & sentient organs.

Experiments have gone far to show the part that the different organs bear in the animal economy — M. Flourens found that in proportion as he sliced off the cerebellum and the animal became weak & unsteady in its motions, until at last these totally failed, while perception & sensation remained: when he took out the cerebral lobes, memory, hearing, vision & will were extinguished tho' the power of voluntary motion remained — The optic thalami, the crura cerebri & the tubercula quadrigemina have functions relative to motion, since in slicing the brain, the operation proceeds with impunity, until it reaches these parts — Majendie observed that a wound of the cerebellum destroyed the power of propulsion: he says, "A

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duck from which I removed a great part of the cerebellum, could swim backward, but made no progressive movement for eight days." —— Certain substances in the stomach seem to produce their effects upon specific parts of the Brain – From repeated & accurate experiments Flourens has determined that hemlock and opium act exclusively upon the crural lobes – belladona upon the Cr.a quad.a and alcohol, camphor & others upon the cerebellum, and the functions of these lobes acted on seem to be those alone affected.† –

Messrs Bell, & Majendie, & others have made some very curious discoveries with regard to the spinal marrow – Mr Bell has shown that there are two anterior chords, connected with the crural ~~lobes~~ cura, & giving origin to the nerves of motion; and that there are two posterior chords, connected with the ~~cerebral~~ cerebellal cura, and appropriated to the nerves of sensation: while there are intermediate chords, which stop short at the med.a oblon.a and are the source of the respiratory

† Phi. Med. Journal p. 216 Vol 8

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nerves. — The accuracy of this division is tested by various experiments, and by many pathological facts. — Irritating the posterior fasciculi of nerves induces their peculiar sensibility, while the irritation of the anterior creates spasmodic action of the muscles — The corpora pyramidalia & olivaria, with the whole anterior part of the spinal marrow were found softened in a man, who had for years, laboured under paraplegia, but had retained his sensibility to the last unimpaired† — M. Baley, a veterinary surgeon of Paris, has observed the same coincidences of morbid appearances, with similar affections in a horse. — There is some variation from these deductions in the experiments of M. Bellingeri, who thinks himself authorised to attribute to the posterior columns of the Sp. Ma. the powers of sensation & extension of the limbs, but to the anterior, flexion alone‡. It is difficult to reconcile these opposing experiments except by supposing that the irritation he employed on the posterior fasciculi, extended partially to the anterior.

† Phil. Med. Jour. p. 404. Vol 7
‡ Am. Med. & Sur. Journal p. 210. Vol 5

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We will now consider how far the functions are modified by a difference in the sensible properties of the nerves. — Nature has been said to be sparing in causes, but profuse in effects — This is true, but this we admit the primitive unity of the vital & nervous principle, yet we cannot doubt, but that it operates in producing distinct effects by appropriate and distinct means — The older Physiologists concluded that these very different functions, sensation and motion were effected thro' one & the same organ — This would be proved erroneous, not only by the incompatibility of these functions, but by the variety in the physical properties of the nerves themselves — Physical, not only the internal arrangement of different nerves is seen to vary, but that also they are dissimilar in the colour and consistency of their medulla — This is particularly observable in the nerves of the senses — Hence Bichat concludes that the "optic nerve would be unfit to transmit tastes, the auditory to propagate impressions made by light." — Confirming by ample experiment the fact that each

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Filament has a peculiar endowment, Bell & Magendie have classified the Nerves into systems. 1st those of sensation. 2d those of voluntary motion 3d those of respiratory motion 4th those that unite all parts of the body in unity of feeling & action. — So far from believing that this division extends too far, we are disposed to think, that future investigations will add many new systems. — In any age are where diversified functions are combined, we observe that the intricacy of the nerves increases. — The trigeminus is a nerve in which the filaments of sensibility & muscularity are united: the irritation of its sup. max branch gives acute pain, and its division affects those muscles of the face not concerned in the assistant actions of respiration. The Portio Dura, & branches of par vagum produce a necessary concert of the muscles of respiration with those of inspiration — : its division occasions little pain, but the expressive action of the eye & face are gone, and there only remains a hideous & discordant grin! These instances are suf-

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ficient to shew the access in that practical medicine may gain from Physiology. The alarming paralysis which has its cause in the brain may be distinguished from that which arises simply from the disendance of the respiratory muscles+; and by this we perfectly understand the admirable precision & effect, with which respiration & expiration are accomodated, in all the wonderful operations of the human voice, from the broad farce of comedy to the impassioned efforts of tragedy and oratory.— We also comprehend how the functions of certain filaments may become impaired, without vitiating functions depending upon other filaments — Thus hemiplegia exists frequently without any corresponding injury to the functions of sensation & respiration. The sensibility remains in the nares, when a coryza has impaired the smelling — The tongue becomes paralysed without any defect of the gustatory function; and Dr Abercombrie relates the case of a man who lost the power of articulation, tho' he retained his control over all

+ C. Bell p. 25

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the muscles of the larynx and face: here the muscles of voice and respiration had lost their requisite consent of action.

Why does an injury of the brain affect the nerves on the opposite side — Jones says the exceptions to this are rare — The nerves of motion are more frequently affected than those of sensation (Bichat). The union of the optic nerves seemed to infer a decussation of their fibres, but the pathological facts were extremely contradictory on this point — These seem now to be adjusted by the observation of Wollaston on the semi-decussation of these nerves; and Dr A. Crawford has recently published an illustrative case, where a hemiplegia of the left side was attended with the total loss of sight ~~in the~~ in the right half of each retina; consequently by the inversion of objects, she only saw those objects that were on the right side of a middle line. Some have alledged that the nerves of motion decussated in the spinal chord, but this is disproved by the experiment of Galen, in which

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he found that a longitudinal incision of the spinal marrow did not cause a paralysis of the nerves. — Gall & S. declare their opinion to be that these phenomena arise from the decussation of the fibres forming the corp. pyramid. and in this opinion many of the modern physiologists coincide. —

There is no visible action of the brain that seems opposite to its function — Two motions have been observed: one synchronous with the systole & diastole of the heart: the other synchronous with respiration — This latter has by Richerand been denied, but his experiments are evidently fallacious, as he observed the brain only when a large part of the cranium had been removed — We adopt the explanation of Lamure, who ascribes it to the compression by the lungs, and parietes of the thorax upon the brain and during inspiration, when a regurgitation takes place, that expands itself principally toward the cranium — During hurried respiration we are very sensible of this regurgitation

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What effect has the blood upon the Brain? Is it simply by its vibratory motion, and distending power, or by the infusion of some essential and vivifying principle? We think that it is by the latter. Large portions of the cranium & brain have been removed without producing syncope, & here the distention of the blood must have been in a great degree removed, while on the other hand, sanguineous & serous effusions, or the venous congestion of apoplexy do not produce that elevation of cerebral function, which an influx of arterial blood is claimed to do. – Sir C. Bell obscures that. Faintness ~~takes~~ is the consequence of the pressure to which the cerebrum has been accustomed being suddenly taken off. But faintness does not take place always when large portions of the cranium have been removed — The explanation of the Brain simply requiring distention is too mechanical & coarse. Why has Nature been so careful to afford to it the first & best fruits of the pulmonic action, and that too in the proportion of 1/5 of the whole product, if a simple

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prepare for her only object — With Cullen we must believe the brain to be specifically glandular, and that, from the blood it exacts some necessary and important principle. All, must have been conscious of the vivacity of thought, and elevation of spirits, following the operation of an unusual stimulus; and all, must have witnessed the exaltement of pulse, and brilliancy of eye, that attends the animating effects of the gifted water; and this, by the way offers an explanation of the fact so mysterious to many, why the eagle, sparkling, flashing eye has proverbially become the indication of genius, and the almost peculiar attribute of the poet, orator, & painter — The explanation is, that as a local arterial plethora of the brain, and the perspicuity of fresh mental energy are frequently co-coincident circumstances; the eye deriving its blood thro' the brain, and in common with it, experiences that quick mutation and fulness of its humours, that give to it, clearness, brilliancy & life — They are coincident effects from the same cause.

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We now come to the consideration of the nature of the nervous principle, & the mode of its agency in sustaining the vital functions. We see in animals two indispensable powers, sensation & motion, and tho' the percipient principle of the one, and the primary cause of the other be inscrutable, yet as they are both manifested thro' the medium of organization, their operation must be resolved by a reference to physical laws. — These two powers relate to external existence, and either act upon or receive impressions from external objects, with which they can only communicate thro' the medium of the organs of animal or organic life, and all the purposes and functions of this life are the creation and preservation of the various parts that concur in the exercise of these two final animal properties — Our intention now is, to consider what agency the nerves exert in this process of organization. The animalization of matter has by different writers been referred to a principle, variously termed: by the Greeks - psyche: by the Latins - anima: by Hippocrates - ipsum facientem: by Hunter - the materia vitæ diffusa

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by the English - the soul. — This last term has been peculiarly unfortunate by leading men to confound with an intellectual, rational & immortal existence, those proper qualities which seem to become incorporate with matter, and to partake of its changes — The soul and principle of vitality tho' no doubt intimately connected, should never be considered as necessarily or indispensably so. — The one may languish, and be oppressed with disease, while the other exists unchanged, amid the crumbling of its mortal tenement — The one in brute animals exists a corporeal structure, equal or superior to that of man, while the other gives but feeble glimmerings of its existence — In vegetable life we see a near approach to the perfection of the one, but not the slightest trace of the other - and finally the one ascends from an existence almost equivocal to its highest perfection, while the other is the noble distinction of man alone — May then have the thinking & intellectual principle of man, been so often united with that which guides the instincts &

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process of organization — On this subject, we cannot in this place give "all the opinions, which as Dr Barclay says, have been repeatedly published before — have" "repeatedly been obsolete — been repeatedly revived — and" "repeatedly become obsolete again"

We shall define the terms used — By vital properties we understand that principle which is communicated to matter in certain states, and induces it to assume organization — By function, we mean the action of matter organized, & possessed of vital properties, And by life we simply designate that state of being in which the functions are in action, or have the capacity of acting.

Two modes have been variously advocated to explain the vital phenomena — The one a certain organism of the materials of our structure — The other refers them to a distinct principle, unallied to & unlike any of the properties of matter — The first class make every thing the result of an organization, which results from the concurrence

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of atoms, brought together under proper circumstances of temperature, proportion &c — As illustrations they adduce the phenomena of the egg; the revivification of hybernating animals: and the production of animalcules by an equivocal generation — Sexual intercourse they view merely as a circumstance apropos at the commencement — Epicurus was the father of these opinions and Lucretius their ingenious and eloquent defender — It is needless to expose the absurdities of these opinions — Admitting with them that the vital principle is a product and not the cause of organization, it is sufficient to ask them how a fortuitous assemblage of atoms could so arrange themselves as to form a structure so admirable adapted to all the functions of Life — To avoid this some have been driven to conclude that the senses suggest their own uses, and were not designed for them — Thus Lucretius says — "Men should avoid the error of supposing that the eyes were made to see, the feet to

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walk" – The most eminent of the supporters of materialism in modern days have been Blumenbach, Cabanis, Cuvier & Lawrence – They all speak of the vital impulse, the vital forces &c, and their tenets admit of no other influence, but that matter organizes itself by its own inherent properties. –

We now shall notice those, who have advocated the existence of a living principle distinct from the body, Aristotle believed in the existence of a supreme animating principle possessed of intelligence, and directing the formation of bodies – Harvey believed in a principle of the same kind, but under the immediate superintendance of the Creator – Hunter believed that it is a principle, pervading all the solids and fluids, but principally the brain & blood, and which, if it be not electricity, he thought it was something analogous.

We think no one can doubt the existence of this principle, ~~and that it~~, and that it is not only distinct from intelligence & perception, but from

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sensation & motion also — We shall not identify it with chemical affinity, because their laws are different and incompatible — Being invisible and intangible we can not describe it, but we may say what it ought to be from a review of its operations, and this is all that the wisest philosophers pretend to claim for chemical action. — where the operation is only seen, but that there is a cause for this, and a material cause no one denies — We believe that the vital principle was originally bestowed upon certain forms of matter in a state of organization, and with the means of perpetuating itself by its own action — From the Mosaic account of the creation we are entitled to believe that not only animals, but all vegetable life was at once advanced to the perfection of their natures, and as this was the first, so was it the last instance of complete existence ab initio. — But now, both animals and vegetables in the form at first of seeds or germs are the results of a creative action in certain more perfect existences, to whose peculiar natures they

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normally are formed — They, from their parent stock receive the first impression of the vital principle, and are supported by this parent tree they arrive at a certain degree of development, and are then dismissed into an independent existence, but prepared with organs whose sole object is, to bring external ~~to its~~ ~~and~~ and inert matter into the sphere of that principle of their nature which can confer organization — This principle we believe supports our system, and actively perpetuated by the action of organs — We see a peculiar fluid — the blood — and peculiar fibres — the nerves every where present, and essential to the life of every part — The first is matter in the first state of vitality, and merely awaiting the influence of the last to assume all the properties of living substance — The particles in the composition of this fluid have not in themselves any inherent qualities similar to those of living particles, but when they are brought in the range of those living particles, they receive from

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their sure properties, and amalgamating with them are said to be assigned — What is this but affinity, call it chemical, vital or what you please — that texture, fibres &c are formed, all admirably adapted to noble functions does not change the nature of the action — The same power that could direct affinities to the formation of a crystal, could equally direct them to these purposes, or restrain their irregular action — All the operations of life when unimpeded by acute causes, continue an invariable and equable course of action. Is this like the irregular action of a thinking & intelligent principle, in which some would wishes to believe? — Every particle of matter is our bodies becomes equally the seat of this vital principle, and to say that it cannot become the property of matter because it did not always reside in this matter, does not invalidate the opinion — Every one ~~knows the~~ discriminates between the accidental and essential qualities of matter, and electricity in Sheep & other

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substances for aught we know, are frequently the accidental but tremendously efficient adhencents to matter. — Is this vital principle one and indivisible, and does it exist ~~not~~ eternally the same, unimpaired & untiring? Is it possessed of the same powers when it animates the feeble frame of infancy, as when it nerves the sturdy muscle of manhood? Rather let us suppose that it is generated to the precise degree that organization may require. — We see its existence in any part dependant on the existence of a chain of communication with the central organ, whose structure & copious supply of blood would argue its function to be the elimination of some powerful & essential agent. —
The vital principle of vegetables is nearly allied to that of animals — some can show irritability — Many of their healthy functions and morbid affections resemble those of animals — They have no internal absorption, and hence the product of organization in them is permanent — The excrescences & deflections of Mss.

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Ibbetson & Dr Lyall prove that there is a fluid in every plant, whose properties are very similar to those of nerves — They call these fluids the nerve or line of life. —

Of the sensible qualities of this vital principle of man we know nothing certain, nor is it necessary that we should identify it with any known chemical substance, but the experiments of Dr Philip & others tend to show that by a chemical & natural agent its operations may be very exactly imitated. —

Galen thought that there was an animal spirit formed by the heart and arteries, more exquisitely elaborated in the ventricles of the brain, and that this was the proximate instrument of the soul — This opinion was extensively received and ably supported — Haller coincided in many of these views — says that there must be a subtle, invisible and rapidly moving fluid in the nerves, but more substantial than electricity, else it could not be confined in tubes —

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Of its generation he says. "Manifestum de cibo nasci et servari quoad" — Descartes, Boerhaave, Mano, Richerand and others contend for a fluid, passing thro' the nerves — Though Mr Abernethy in been that Hunter conceived it to be some subtile, mobile, invisible substance superadded to vital matter — Mr Lawrence who seems to treat Hunter's opinion indirectly in this subject, triumphantly asks, "Why does the irritability of a muscle need such an explanation, more than the electric ~~[illegible]~~ attraction of a salt"? — Unfortunately for Mr Lawrence's comparison he has lived to see that the electric principle of a salt is no longer such an inscrutable mystery. —

Prochaska, Le Galleis & others think that this fluid is generated in the nerves equally with the brain. — Whatever this fluid may be there is a striking analogy discovered between it and the Galvanic fluid, which has of late attracted much attention — By Galvani & Volta it was proved that muscular contractions can

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be produced by this agent, and that animals had the power as thus thought of generating it from the air. — Mr Good says that "It is almost reduced to a certainty that this common aura constitutes the nervous fluid — Philip's experiments shewed that by the Galvanic influence digestion proceeded tho' the nerves of the stomach were divided — that the accelerated motions of respiration were excited — that the death of the blood was retarded — and that the nervous fluid could be conveyed thro' a galvanic conductor, and there perform its function — What stronger proof can be required of the materiality of the nervous fluid?

Mr Earle repeated & confirmed these experiments. — Mr Brodie denies the dependance of secretion upon the nerves, but it seems probable that he allowed the ends of the divided nerves to remain in contact, or near each other with a fluid intervening, which is sufficient to conduct the galvanic or nervous stream. —

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H. Earle Esqr in a paper on the influence of the Nerves in regulating animal heat, has detailed a case, where the temperature of a paralysed limb was raised from 71° to 77° by the application of electricity.

Wills & Philips has already applied this agent to important medical purposes, and a late paper announces that Magendie has cured a alleviated amaurosis by connecting the nerves of the Eye in a galvanic circle

Some have exclaimed against the idea of making the brain and nerves a voltaic pile — but the palpable proof of galvanism being within in the compass of animal powers is given by the phenomena of the Gymnotus or Electric Eel — Not only do they form this agent, but they can direct it to any part, and it is remarkable that the nerves connected with their electrical organs exceed those that go to all other parts in the proportion of 20 to 1.

These facts are curious, and the coincidences of

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the two principles striking — We know that the electric or galvanic fluid is diffused thro' all nature, and is the agent equally of her humblest and most magnificent acts — at one moment rending the "gnarled and unwedgeable oak" — at another, uniting the elements of the simple rain drop. — Its source is boundless — its energy ceaseless.

With regard to the offices of the nerves in man we can say but little — We shall not examine the noted experiments of Bichat, in which he attempts to prove that the olfactory and optic nerves are not essential to the functions of seeing & smelling, but that these depend on the 5th nerve — Not only many observations disprove this, but there were too many sources of error in these experiments to allow of any deduction from them. In man the senses are fair, but in other animals, there may be none — Thus the sensibility of bats to objects & the un-

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~~throwing~~ erroneously with which birds and fish possess a long migration have been ascribed to other forms of sense. —

The structure of the senses is in most animals very analogous in form, tho' they are very various in location — When there is no distinct organ, the impressions seem made by what Hunter calls "common sensation" — We must believe that the modification of sense depends upon a specific difference in the disposition of the sentient extremities rather than any difference in the animal fluid inhabiting them — We have heard much of the transposition of the senses — Thus Dr Goldhorn of Phil.a has experimented to shew that the facial, particularly the frontal nerves are sensible to light, and a late French Author has lately proposed the cultivation of the auditory faculties of the portio dura in cases of congenital deafness. Bats are also distinguished by touch; but this and the other instances quoted seem but modifications of the common sensibility — We have reason to believe that

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sentient nerves appreciate only their appropriate stimuli.
— ~~Dubois~~ Magendie lately mentioned that he had irritated the retina without creating any symptom of pain, and taste has remained when ordinary sensibility was lost — In the eye and ear there is a peculiar mechanism to modify the impression agent, but in the organs of taste, the parts are so arranged as to allow the greatest expansion to the nerves.

The cause of sensation — has been attributed first — to the vibration of the nerves — secondly — to the motions of a particular fluid — This last opinion has been vigorously supported by Erichsen in his work on Insanity. He supposes that this fluid has its particles at various distances, and that by impressions, a motion and approach of particles may be propagated thro' all the nerves to the brain — hence he has his nervous impression & his cerebral impression — another opinion is that of Darwin — he supposed that the nerves have powers of contraction like to those of a muscle, and that by the various exercise of this power, all the phenomena of sensa-

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tion are produced. — We must reject all these opinions, for we did they correspond with the sensible qualities of the nerves, we could challenge their advocates to show here the vibration of a chord, the motion of a fluid, or the contraction of a fibre could produce any distinction of effect, except what might arise from a difference in the degree of force — It is only in the varied operations of the material vital principle, that we can glimpse at an explanation — Far be it from us to suppose that this is the perceiving principle: we only mean that by an action generated in this agent by the impression of material substances, the immaterial essence, which we call mind becomes conscious of external objects, and an idea or sensation is the consequence — This animal fluid is the instrument of the soul, and by a mysterious connexion mediates between it and the material world.

It is only by a change of action, or alteration of nature, very little resembling the unvarying simplicity of a mechanical cause, that we can account for the va-

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ricty and compass of our sensations — But lest it should be said that no quantities of any material agent would be equal to this effect, it should be understood that our sensations are compound, and made up of elementary sensations comparatively few in number — The theory of sounds illustrates this remark — The nerves do not essentially require the impression of external objects to cause sensation, but they sometimes spontaneously assume that state or change production of sensation — Thus a blow on the eye, or an inflammation will give in utter darkness the appearance of sparkles, and the exciting of galvanic action by means of the tongue and different metals will give the idea of a flash of light to the experimenter, but not to a bystander — Sounds are often heard in the ear, and the eye will sometimes involuntarily see colours — These phenomena are generally attributed to the imagination, but improperly, for its creations can be suppressed or controlled, but these spontaneous sensations cannot.

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a nerve, irritation of that, the result of their natural excitants — We cannot demonstrate the materiality of the ~~the~~ nervous principle of the senses as of other organs; but there are many analogies to prove that it is also the creation of an organic action — Thus it becomes ~~exhausted~~ exhausted by exercise — it is renovated by rest, and is accumulated by immediate vascular action.

The improvement of the senses by exercise has been urged against the materiality of the sensient principle, for "hers" it is said "can a physical effect be heightened simply by reiterated operations — We deny that the organs of sense are can improved — Thus a distant object may seem obscure, but being informed of its nature we immediately recognise it, and it appears more distinct than before: here the vision is not increased, but the attention being directed, the mind observes features not before observed — and this will account for the refinement of the ear, tongue & smell.

We now come to the other important function of

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the nerves — that of motion — and as in the execution of this function, the brain, the nerves and the muscles are inseparably (in their natural state) connected, it is very difficult to discriminate the duties of each — The explanation of muscular contraction upon the principle of an inherent irritability, or vis insita was the chief pronouncement of Hallers ~~opinion~~ fame — ~~They~~ supposed that this was a peculiar principle distinct from nervous energy, and in proof of this showed many experiments and adduced many analogies — Animals thought to want nerves were seen to be irritable — this property remained after death, or in a muscle separated from the body — the sensibility & motivity of a part (supposed to depend upon the same nerves) did not appear to correspond always — and to prove that irritability might be a property of fibre, the contraction of certain plants as the sensitive plant & venus fly traps by stimuli were adduced — The chief errors in Hallers theory seem to arise from ~~this supposing~~ its opening the identity of the nerves of sensation and of motion, and

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that the brain was the sole seat of nervous power — This generally accredited this theory met with many startling and weighty objections, and has met with a little more conclusive refutation in the experiments of Le Gallois, Brodie and others — Against Haller's theory have been urged the sensibility of the heart to the state of the feelings; that its action is not proportionate to the quantity of blood in it; that its action becomes more frequent after the loss of a considerable quantity of blood; and that it can continue to act when empty. These and many other facts tend to subvert Haller's theory; and surely it is more philosophical to attribute the regular action of the stomach, the stated contraction of the bowels and of other organs to some uniform impression of the nerves, rather than to the simple irritation of ~~their~~ varying contents. By this theory the gall bladder and the testicles would be stimulated by their appropriate fluids; but the action of these organs only takes place at certain periods — There are we to suppose that those fluids - the bile & semen are

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able to suspend their action, notice the proper occasion arise for it — They are present in their cavities, but no action results, and if the theory be true, we have here a cause without an effect — The same reasoning will equally apply to the function of the womb — In support of Haller, the smallness of the nerves of the heart (and some denied that it had any) was quoted; but to this, we reply that the nervous energy of an organ does depends upon its supply of blood, and of nerves conjointly — Now in the heart there is a more rapid succession of highly oxated blood than in any other part, and in this way may we account for the energy of that organ.

The experiments of Le Gallois have gone far to show what relation the heart bears to the brain and spinal marrow. I shall not enumerate them — It is sufficient to say that their accuracy has been tested by the Ld. Prof. of Anatomy in this University; who has also drawn ~~some~~ some important surgical principles from the truths they develope.

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from any part of the spinal marrow, collected ~~that the~~ by means of the sympathetic nerve, whose object is to lay under contribution all the parts whence it arises — As the heart then is not dependent upon the brain, it was necessary to show in what manner its destruction proves fatal, and this he has done by proving that it is from asphyxia, which is the effect of the removal of that part of the medulla oblongata, whence the respiratory nerves arise — As the vitality of any part depends upon the integrity of the circulation, and of that part of the medulla spinalis whence its nerves arise, it follows that large portions of the medulla may be destroyed, without arresting but merely accelerating the action of the heart, and it is possible by limiting the circulation, to retain life in any insulated portion of an animal — Thus the thorax alone may live, if the power of the heart be there concentrated by putting ligatures on the carotids, and abdominal aorta, and then removing the head, and all the inferior parts — Le Gallois also shows that the voluntary muscles

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derive their powers from the medulla spinalis, but that their ~~influence~~ direction depends upon an influence derived from the brain — Thus a division of the spinal marrow will create two nervous centres, each capable of producing motion, but not in concert — Mr. Philips has impugned many of the conclusions of Le Gallois — He contends that the voluntary and involuntary muscles are both independent of the nervous system, but that the former are always, the latter, sometimes influenced by the nerves — Now the point that Le Gallois attempted to investigate was not whether any artificial substitute could be found for the nervous energy, but whether in the animal economy this was the natural and only agent of muscular contraction — Philips does not discriminate between the irritability of the muscular fibre and its healthy and natural contraction — At page 139 of his Inquiry he says — "When both (that is: the Brain & S. M.) were removed the peristaltic motion of the intestines remained unaffected. It continues till the parts become cold, so that when the intestines exposed to the air have

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lost their power, that of those beneath them remained — Now upon this admission we would ask, why did those cooped lose their power more rapidly than the others, if their action did not depend simply upon the air — And yet he concludes from this that the intestines are entirely independent of the nerves —
He found that stimuli affected the heart by being applied to any part of the brain or marrow, but the muscles of voluntary motion only when it acted upon the immediate source of their nerves — This would corroborate the opinion that the involuntary muscles receive their influence from all parts of the central organ — We believe that the nervous influence is the cause of contraction in all the muscles, but there must be some peculiar quality in the muscular fibre itself in relation to this power — We know that this remains after life, or even when the part is separated from the body — Dr. Philip and many older writers attribute it to the mechanism of the muscular fibre itself. — others to an inherent quality — Now any mechanism can give a quality not before possessed it totally inconceivable, and we have no reason to think it inherent — since we see it ba-

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We believe it to be the result of a nervous action upon the blood, or in plain terms a, secretion — In paralysis, tho' the power of the will be lost on the muscles, yet their irritability remains, but this does not more militate against our opinion, that it does against that which denies our temperature from a nervous action — It only proves the nerves of secretion to be different from those of motion — The energy of muscular contraction is generally proportioned to the energy of volition, and a structure of muscle indicating strong powers of contraction — Depriving a limb of blood renders its muscles inspirative, and increasing the quantity gives increased energy — It is also observed that the integrity of the veins is necessary to the functions of the muscles. During exercise an increase of arterial action is safely endured that in a state of rest would prove highly injurious — We cannot suppose that the perspiration is the only means of modifying this state of the circulation, as this is entirely too partial and local in its operation — We are led to believe that the action of the muscles requires and consumes the additional

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quantity of the sanguineous principle, and thus prevents the injury of excess. — This if true would prove the beautiful economy of our nature, since the increased vigour of the heart's action would be shown to answer an important design, and not to be the unavoidable effect of our mechanism. — From these considerations we believe contractility to be the effect of the arterial and nervous action, and not a quality bestowed irregularly when & how no one knows. — When would be the absurdity of explaining muscular contraction in this way — that the muscular molecules are attractive of each other — that the cellular sheath insulates each chain of particles & prevents any lateral approximation of fibres & that an influence derived from the nerves increases the attractive powers, and causes a mutual approach and a consequent contraction. — We do not adopt any of Fontanaus or Richerands notions of its being the effects of oxygen, hydrogen &c, but when we see that muscles have a force of adherence much greater in life than after death; that they evidently contract under the influence of nervous action and certain physical causes, we hold in

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almost demonstrated, that they contain a principle of attraction, and that their action results from an increase of this principle. Whether this principle be a material one, or the effects of an unknown and incomprehensible ~~principle~~ operation, or have elsewhere endeavoured to shew.

The power of muscles is generally known to increase as they approach the limits of their contraction, & this shews that they obey one of the ordinary laws of attraction.

We now feel compelled abruptly to conclude our remarks, which have been protracted to an unintentional length, not from an arrogation of superior knowledge, but from the difficulty of condensing a subject, on which an accumulated mass of facts, but few principles.

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The writing of this essay is very difficult to read — To a subject so intricate the candidate ought not to have added the labour of deciphering his handwriting —

The author appears to have studied his subject very attentively —

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